



**National
Foreign
Assessment
Center**

Simulations of Soviet Growth Options to 1985

A Research Paper

*ER 79-10131
March 1979*

This publication is prepared for the use of US Government officials, and the format, coverage, and content are designed to meet their specific requirements. US Government officials may obtain additional copies of this document directly or through liaison channels from the Central Intelligence Agency.

Requesters outside the US Government may obtain subscriptions to CIA publications similar to this one by addressing inquiries to:

**Document Expediting (DOCEX) Project
Exchange and Gift Division
Library of Congress
Washington, D.C. 20540**

or: **National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161**

Requesters outside the US Government not interested in subscription service may purchase specific publications either in paper copy or microform from:

**Photoduplication Service
Library of Congress
Washington, D.C. 20540**

or: **National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(To expedite service call the
NTIS Order Desk (703) 577-4650)**



**National
Foreign
Assessment
Center**

Simulations of Soviet Growth Options to 1985

A Research Paper

*Research for this report was completed
on 1 December 1978*

Comments and queries on this unclassified report
are welcome and may be directed to:

Director for Public Affairs
Central Intelligence Agency
Washington, D.C. 20505
(703) 351-7676

For information on obtaining additional copies,
see the inside of front cover.

*ER 79-10131
March 1979*

Contents

	<i>Page</i>
Foreword	v
Introduction	1
A Baseline Projection of Soviet Growth	2
Key Assumptions	2
Patterns of Production and Final Demand	3
Patterns of Fuels Use and Trade	5
Hard Currency Trade and Finance	7
Alternative Scenarios Depicting Soviet Policy Options	8
The GNP Costs of Oil Shortages	9
Conservation Required To Avoid Energy Shortfalls	9
Other Domestic Policy Options	9
Foreign Trade Options	13
Sensitivity of Model Results to External Contingencies	15
Model Simulations Involving a Mix of Options and Contingencies	18
Some General Observations	22

Appendix

A Summary of the Econometric Model of the Soviet Economy	25
--	----

Tables

1.	USSR: Projected Fuel Balances for Baseline Scenario	5
2.	USSR: Projected Net Fuel Exports for Baseline Scenario	6
3.	USSR: Projections Under Possible Domestic Policy Options	10
4.	USSR: Assumed Pattern for Reallocation of New Fixed Investment	12
5.	USSR: Assumed Pattern for Reallocation of Nonagricultural Employment	12
6.	USSR: Model Projections Under Possible Foreign Trade Options	13
7.	USSR: Model Projections Under Major Contingencies	16
8.	USSR: Alternative Views of Growth Prospects for 1978-85	20

Figures		Page
1.	Baseline Scenario: Trends in Oil Production and Use	5
2.	Baseline Scenario: Projections of Net Soviet Hard Currency Exports of Fuels	6
3.	Baseline Scenario: Projections of Net Soviet Exports of Fuels to the World	6
4.	Baseline Scenario: Projections of Net Soviet Exports of Fuels by Region	7
5.	Baseline Scenario: Trends in Hard Currency Exports and Imports	7
6.	Baseline Scenario: Trends in the Debt-to-Export Ratio and Debt Service Ratio	8
7.	Debt Service Case: Debt Service Ratio When Debt Service Trigger Is Applied	15
8.	Alternative Oil Production Profiles	17
9.	High Oil Case: Net Exports of Oil to Hard Currency Countries	17
10.	Credit Ceiling Case: New Credit Drawings	19
11.	Credit Ceiling Case: Debt Service Ratio	19
12.	GNP: Comparative Projections Through 1985	21
13.	Domestic Oil Use: Comparative Projections Through 1985	22
14.	Net Hard Currency Oil Exports: Comparative Projections Through 1985	22
15.	Hard Currency Debt Service Ratio: Comparative Projections Through 1985	23
A1.	General Flow Diagram of the Soviet Economic Model	24
A2.	Condensed Model Structure	27

Simulations of Soviet Growth Options to 1985

Foreword

In *Soviet Economic Problems and Prospects* * published in 1977, we argued that the USSR faces a period of unusual economic strain over the next decade. Rising costs of raw materials, impending energy shortages, slowing labor force growth, and sluggish productivity gains pointed to a continuing slowdown in Soviet growth in the 1980s.

That assessment still stands, in our view. The 1977 paper, however, used a very aggregative analytical framework and dealt with a relatively small range of policy options that might be adopted by the Soviet leadership in an effort to avert a slowdown or cushion its effects. In this paper we employ a large-scale macroeconomic model of the Soviet economy—put together over the past year—to study a wider selection of the tradeoffs and contingencies that Soviet policymakers face. Analysis using the model involves a more integrated view of the Soviet economy than was possible in our earlier study and allows us to examine explicitly issues—such as the effects of energy shortfalls and foreign trade constraints—that could not be fully considered before.

The model is still at an early stage of development and some of the scenarios introduced rest on thinly supported assumptions. Therefore, the present findings should not be taken as a revision or modification of our earlier estimate. Instead, we put this paper forward to elicit discussion and criticism both of the scenarios examined and the usefulness of a model-based approach in this kind of analysis.

* *Soviet Economic Problems and Prospects*, ER 77-10436U, April 1977, Unclassified.

Simulations of Soviet Growth Options to 1985

Introduction

Recently CIA's macroeconomic model of the Soviet economy was described at some length in an unclassified report.¹ That report identified a period of experimentation as the next step in the development of the model as a tool of economic analysis. An essential part of learning the uses and limits of the model is the application of the model in scenario analysis—the process of examining the possible effects of different policy choices and alternative external economic events on Soviet economic development. The present paper reports on a series of experiments conducted to test the model—summarized in the appendix—and to improve the realism of the scenarios run through it. Because the model was specifically designed to deal with the effects of energy shortfalls and foreign trade constraints, many of the scenarios have to do with attempts to provide enough energy to the economy while keeping the foreign trade sector in reasonable shape.

Since it is convenient to analyze the implications of various scenarios against a common reference point, we first develop a baseline case for the period 1978-85. The baseline projection clearly is a point of departure, not an estimate, because it assumes that policy choices—for example, in the allocation of manpower and investment—are frozen in the pattern revealed through 1977. In other words, historical trends are not continued, nor do policymakers change their minds when bad news accumulates.

With the baseline backdrop in hand, the paper then suggests a number of policy options open to a Soviet leadership determined to prop up rates of economic growth while maintaining a viable position in trade with hard currency countries. First, we estimate Soviet growth potential if energy supplies were sufficient to meet projected demand. Then we examine a series of alternative domestic policies keyed to higher labor force participation rates and reallocation of manpower

and investment resources. In the foreign arena, we assess the impact of cutting oil exports to Eastern Europe, diverting gas exports for hard currency to domestic use in place of oil, belt-tightening with respect to imports other than oil or grain, and the observance of a ceiling on the Soviet debt-service ratio. Finally, the model's response to changes in the overall economic environment is tested by considering different trends in domestic oil production, world oil prices, growth of Western markets for Soviet exports, and Western lending policies toward the USSR that are beyond the control of Soviet policymakers.

The main purpose of this paper is to exercise the model and gain experience in scenario analysis. Therefore, we made no attempt to put together a most likely set of Soviet policies or external contingencies, since such an assessment goes beyond the limited scope of the present study. In addition, the simulations are carried out only through 1985. A paper intended as a new estimate of Soviet economic prospects would have to deal with a longer span of years because the manpower crunch becomes most severe in the mid-to-late 1980s and because many of the policies affecting domestic investment in the early 1980s have most of their consequences in the second half of the decade.

Nonetheless, the implications of some of the scenarios go right to the heart of the problems confronting the Soviet leadership. The "what if" analysis seems to say that the Politburo cannot stave off a reduction in rates of economic growth by simply exercising the traditional policy levers under its control.

As we argued in *Soviet Economic Problems and Prospects*, current growth prospects reflect an unusual coincidence of factors that sharply restrict Soviet growth potential. Demographic trends will prevent much growth in the labor force during most of the 1980s. The likely peaking of domestic oil production

¹ *SOVSIM: A Model of the Soviet Economy*, ER 79-10001, February 1979, Unclassified.

will bring about a dramatic shift in the Soviet energy balance. Difficulties caused by traditional inefficiencies in the investment process are already being accentuated by the rising capital costs of developing new sources of raw materials. The results of this analytical study of Soviet growth options simply serve to reinforce our earlier assessment that the USSR is in for a prolonged period of shrinking growth prospects.

A Baseline Projection of Soviet Growth

The central purpose of our analysis is to suggest how policy shifts and uncertain events could change the picture of Soviet economic growth projected by our macroeconomic model of the Soviet economy. This requires a reference against which to judge the impacts of these changes. We have chosen as a reference a projection of Soviet growth through 1985 that reflects present policies—in such areas as manpower, investment, foreign trade, energy, and defense—in a stable domestic and international environment.² Later we will examine the impacts that changes in both policies and the economic environment would have on growth prospects.

Key Assumptions

This baseline outlook is based upon several key assumptions. They are described here in some length so that later scenarios, which often involve modifications of these assumptions, can be more easily understood.

- *Investment.* New fixed investment is distributed among producing sectors as it was in 1977.
- *Fuels Production.* Oil production peaks at 590 million metric tons in 1980 and falls to 500 million tons in 1985.³ The output of gas grows at an annual rate of about 6 percent, a little more than twice the rate for coal.

² The assumptions underlying the baseline projection are a matter of convenience. They certainly do not reflect the most likely set of policies that Soviet planners might advocate over the next decade.

³ The production figure of 500 million tons represents the high end of the range for Soviet oil production in 1985 estimated in *Prospects for Soviet Oil Production* ER 77-10270, April 1977, Unclassified. Production in 1985 could be as low as 400 million tons.

- *Defense.* Personnel expenditures grow by 1.5 percent a year, nonpersonnel expenditures by slightly more than 4 percent, and military manpower is stable.

- *Total Factor Productivity.* Total factor productivity (average output per unit of labor and capital combined) in nonagricultural producing sectors is flat over the 1978-85 period, and in agriculture it rises slowly. Both assumptions are consistent with the general historical record. The productivities of capital and labor taken separately vary over time based on estimated production function relationships.

- *Energy Allocation Policy.* Energy-producing sectors and public and private consumption are given priority when oil deliveries are insufficient to meet the full demands of all users. Under all circumstances, they are allocated 100 percent of their nominal requirements.

- *Fuels Trade.* Net exports of oil, coal, and gas for hard currency are the residual left from domestic production after domestic deliveries and net exports to Communist and other countries have been met—unless import floors are reached first. Soviet exports of oil to Communist countries are assumed to increase to 95 million tons by 1980 and to hold at this level through 1985. The real export/import price of Soviet oil remains constant through 1980, then rises at 5 percent a year.

- *Hard Currency Trade.* Soviet exports to the developed West of commodities other than fuels grow 9 percent annually in real terms. We also assume that grain imports are given priority in Western trade and that there is a minimum level of other hard currency imports acceptable to policymakers. We take half the 1977 ratio of Western imports of manufactured goods and nongrain foodstuffs to gross national product (GNP) as a floor below which such imports are not allowed to fall in any single year. As for trade financing, new medium- and long-term credit drawings are assumed to increase 11 percent per year in nominal terms (5 percent in real terms).

- **Population and Employment.** The able-bodied population grows by 1 percent annually through 1980, with the rate declining to essentially zero by 1985 as the demographic effects of an aging population take hold. Participation rates are almost flat through the entire period. Agriculture's share of the total labor force falls from about 24 percent in 1978 to 20 percent in 1985, a rate of decline consistent with trends of the last 10 years. The distribution of the nonagricultural labor force among producing sectors is based on 1977 sector shares.

- **Weather.** Normal weather conditions based generally on the last several decades are assumed for all years throughout the 1978-85 period.⁴

Patterns of Production and Final Demand

In the baseline projection, a continuation of present Soviet policies, even in a stable economic environment, leads to serious economic difficulties in the early 1980s. These problems are reflected in annual average projected growth rates of all major economic categories as follows:

	1976-80	1981-85
GNP	3.6	2.5
Industrial Output	3.8	3.0
Agricultural Output ⁵	2.8	0.9
Consumption	3.2	2.1
New Fixed Investment	4.0	2.4
Per Capita Consumption	2.3	1.2

These projections are sensitive to analytical assumptions in two key areas: the linkage between energy deliveries and capital utilization, and the linkage between capital utilization and the utilization of labor services. The baseline reflects midrange assumptions regarding the elasticity of capital utilization in the face

⁴ This is not to say that these conditions are necessarily expected for 1978-85. Some basis exists for arguing that Soviet weather patterns will return by the 1980s to conditions that prevailed before 1965 (See *USSR: The Impact of Recent Climate Change on Grain Production* ER 76-10577U, Unclassified). An assumption of normal weather—neither unusually good nor unusually bad by recent standards—is a reasonable reference for this study.

⁵ The baseline projections of agricultural output are based on normal weather conditions and measure agricultural output in terms of value added. Growth rates for net agricultural output average about 1 percentage point higher.

of energy shortfalls (the percentage change in active use of a given stock of capital divided by the percentage change in energy supplied to it).⁶ Similar analyses with alternative assumptions give a range of GNP growth rates of about 0.5 percentage point, with the midrange elasticity assumptions giving results generally in the middle of the range. However, the trends remain unchanged.

The baseline also assumes that capital and labor inputs are independent, so that the level of labor services is maintained in the face of any incremental losses in capital utilization. This is an optimistic assumption that leads to the highest output whenever growth is constrained by energy supplies. The opposite, pessimistic assumption of fixed proportions between capital and labor inputs would impose an equal penalty on both capital and labor use whenever energy is in short supply. This assumption would reduce the baseline average growth of GNP in 1981-85 by as much as 0.8 percentage point, if all other conditions were kept constant.

The annual projections suggest not only a general fall in growth rates over the entire period but also a sharp acceleration of this trend toward the later years. This acceleration is caused in the simulation by oil shortages interacting with problems in financing hard currency trade. During the early part of the 1978-85 period, the simulation indicates that the Soviets would be able to afford all of their basic hard currency import requirements—grain, at least a minimum level of manufactured goods, and even oil when it becomes necessary to import it from the West. But, because of falling domestic oil production, rising domestic requirements, and assumed maintenance of oil exports to Eastern Europe, this situation no longer holds true in the last three years.

⁶ Assumptions of baseline capital elasticity vary among sectors to reflect the capital stock used in each sector. In those sectors where equipment is a large share of total capital, capital utilization is assumed to be very sensitive to energy supplies. In other sectors where structures dominate the capital stock, we assume that capital use is less sensitive. Baseline elasticity values ranged from 0.6 to 1.0.

In 1983-85 a choice has to be made since import needs in all three areas cannot be fully met. We assume that hard currency oil imports will be cut back when necessary to allow full imports of grain,⁷ to keep imported manufactured goods at least at their assumed minimum level, and to maintain oil exports to Eastern Europe. This means that domestic oil deliveries fall as a percent of nominal domestic demand:

Year	Percent
1980	100
1981	100
1982	100
1983	93
1984	87
1985	82

The consequence of this forced reduction in domestic oil allocations is sharply reduced growth rates for 1983 and beyond in all aggregates projected by the model.⁸ The projected average annual rate of growth (AARG) of GNP during 1981-85 is then only 2.5 percent, more than 1 percentage point below the comparable figure for 1976-80. During 1981-85, increases in per capita consumption could be sustained at little more than 1 percent per year, only half the rate projected for the earlier period.

The baseline scenario also leads to shifts in the structure of both production and final demand. The

⁷ Hard currency grain imports projected by the model are in the range of 25-30 million tons per year for 1981-85, which is consistent with our assessment in *USSR: Long-Term Outlook for Grain Imports*, ER 79-10057, January 1979, Unclassified.

⁸ The rate at which growth in GNP falls in response solely to a decrease in domestic energy deliveries is equivalent to a pure energy elasticity—the percentage change in GNP which results from a given percentage change in energy supply, all other factors remaining constant—of about 0.4 under the optimistic assumptions of the baseline. This implies some substitution of labor for capital in the face of energy shortfalls and assumes that capital utilization is cut back first in the least efficient capital stock in each sector. The figure could rise to as high as 0.8 under alternate assumptions, which would simply make the deceleration in growth much sharper once the energy constraint takes hold. In particular, the larger elasticity is consistent with the periodic shutdown of full plant operations for all plants regardless of their relative energy efficiencies. We also assume throughout that the USSR has sufficient flexibility to substitute fuels at the margin. To the extent that this is not the case, GNP would be reduced still further by a given drop in domestic energy deliveries and the elasticity could approach 1.

share of government expenditures would rise by about 1 percent—from 13.8 percent in 1978 to 14.8 percent of GNP in 1985—because the assumed annual growth in defense spending of about 4 percent is substantially above the average GNP growth of less than 3 percent for 1981-85. This forces the share of GNP devoted to private consumption to fall by 1 percent between 1980 and 1985.

On the production side, industry's share in GNP rises from 42.1 percent to 43.6 percent between 1978 and 1985 at the expense of an almost equivalent fall in agriculture's share. The underlying causes of this shift are best seen by looking at projected patterns of average annual growth rates for labor and capital inputs:

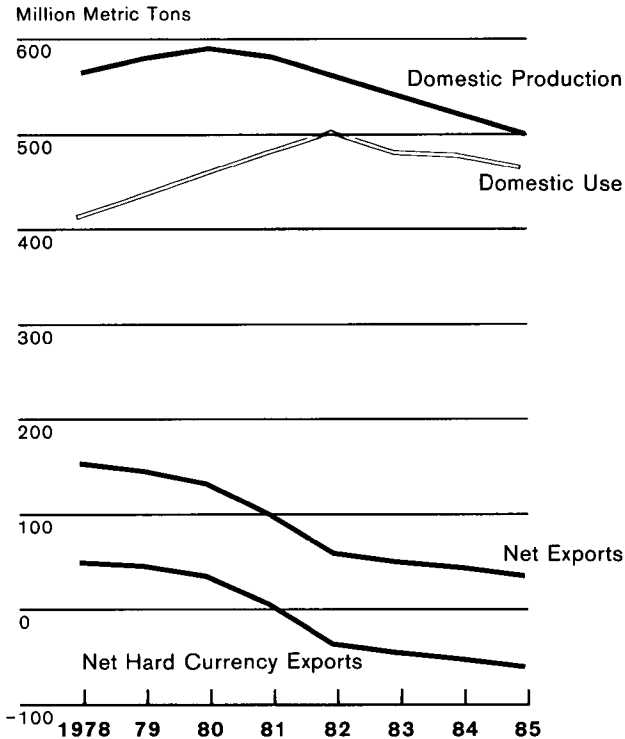
	1976-80	1981-85
Employment		
Agriculture	-0.8	-0.5
Nonagriculture	2.1	1.6
Active Capital		
Agriculture	7.8	2.4
Nonagriculture	7.0	5.0

We have assumed a fall of 0.5 percent per year in agricultural employment. Superimposed on other demographic and labor force parameters—slow growth in the able-bodied population, stable participation rates—this still leads to a marked deceleration in the growth of nonagricultural employment. Capital use shows a similar trend. Because capital utilization rates depend on the level of energy deliveries to each sector, the growth in active capital—the gross capital stock adjusted by the utilization rate—falls sharply with reduced oil allocation during 1983-85. The effect on agriculture is particularly acute because it is a heavy oil consumer.

The growth of active capital in nonagricultural sectors holds up much better because (1) these sectors rely relatively more on gas and coal, which are not projected to be in short supply, and (2) energy and fuel producing sectors in industry are given 100-percent allocations of energy and fuels on a priority basis.

Baseline Scenario: Trends in Oil Production and Use

Figure 1



Unclassified

578563 3-79

Patterns of Fuels Use and Trade

Developments in the energy sector shape much of the story summarized in the economic aggregates. These simulations assume that oil production peaks in 1980 at 590 million tons and then falls back to 500 million tons by 1985. The baseline projections based on this output profile show a steadily rising domestic use until the hard currency constraint is hit in 1983 (figure 1). In order to meet export obligations to Eastern Europe, net hard currency oil trade would have to shift from a strong net export position in 1980 to a large net import position in 1985. Oil imports based on assumed foreign-exchange priorities are insufficient to meet domestic needs after 1982, as the hard currency constraint in 1983-85 forces a sharply reduced growth in hard currency oil imports. This then causes domestic use to fall slowly after 1982 under the combined impact of reduced domestic production and insufficient imports. Overall Soviet net oil exports fall sharply

Table 1

USSR: Projected Fuel Balances for Baseline Scenario

	Domestic Production	Domestic Consumption	Net Exports
1980			
Oil (million metric tons)	590	458	132
Coal (million metric tons)	769	746	23
Gas (billion m ³)	420	384	36
1985			
Oil (million metric tons)	500	464	36
Coal (million metric tons)	854	825	29
Gas (billion m ³)	560	500	60

after 1980 but remain positive through 1985 on the strength of heavy exports to Eastern Europe and the restraint imposed on hard currency imports by foreign exchange considerations.

The projected fuel balances for 1980 and 1985 under the baseline assumptions are shown in detail in table 1. The model projects net oil exports to fall from 27 percent of domestic production in 1978, to 22 percent in 1980, and to only 7 percent in 1985. The rapid rise in coal and gas exports partially offsets the slump in oil exports (table 2). Net hard currency exports of oil fall substantially by 1980, but net earnings on total trade in fuels are much more stable because of a combination of rising prices and increased quantities of coal and gas exports. After 1980, though, even these factors fail to keep net hard currency exports of fuels from falling to a large deficit position.

Over the full 1978-85 period, the net value of hard currency fuel exports in the baseline case follows the general trend of net oil exports (figure 2). Because of rising fuel prices and increases in the net volume of gas and coal exports, the net value of Soviet fuel exports changes little through 1980, after which it plunges quickly to a persistent deficit level. However, the influence of growing gas and coal exports holds the net hard currency trade deficit in fuels to about \$4 billion in 1985.

Table 2**USSR: Projected Net Fuel Exports
for Baseline Scenario**

	Hard Currency	Communist	Other	Total
1980				
Total (million 1977 US \$)	4,900	7,000	Negl.	11,900
Oil (million metric tons)	34	95	3	132
Coal (million metric tons)	11	11	1	23
Gas (billion m ³)	20	31	-15	36
1985				
Total (million 1977 US \$)	-3,900	9,600	-700	5,000
Oil (million metric tons)	-59	95	0	36
Coal (million metric tons)	15	13	1	29
Gas (billion m ³)	48	43	-31	60

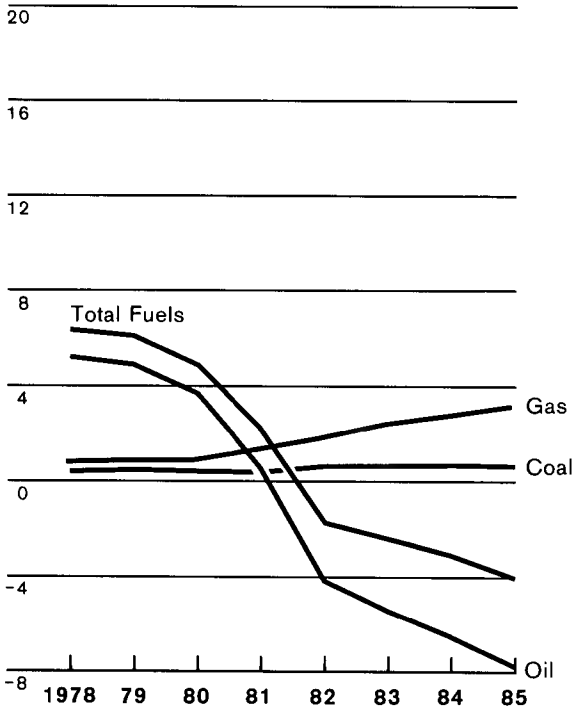
The picture for overall Soviet fuels trade is much different in the baseline simulation (figure 3). The value of net oil exports falls dramatically after 1980, and so does the value of net fuel exports. The net volume of oil trade in 1985 is considerably above zero (see figure 1) because exports to Eastern Europe are maintained at a substantial level. Nevertheless, the net value of oil trade is in deficit by 1985 because volume traded in the higher priced hard currency oil market shifts sharply to a net import position while that in the lower priced CEMA (the Council of Mutual Economic Assistance) market holds steady at a net export of 95 million tons.⁹ Unlike oil exports, though, net exports of total fuels level off after 1982 in value terms because the prices and volumes of net gas and coal exports rise strongly over time for all regions.

⁹ We have assumed that CEMA oil prices remain below world market levels through 1985. If they reach world levels by then, this projected deficit could be reversed.

**Baseline Scenario:
Projections of Net Soviet
Hard Currency Exports of Fuels**

Figure 2

Billion 1977 US \$



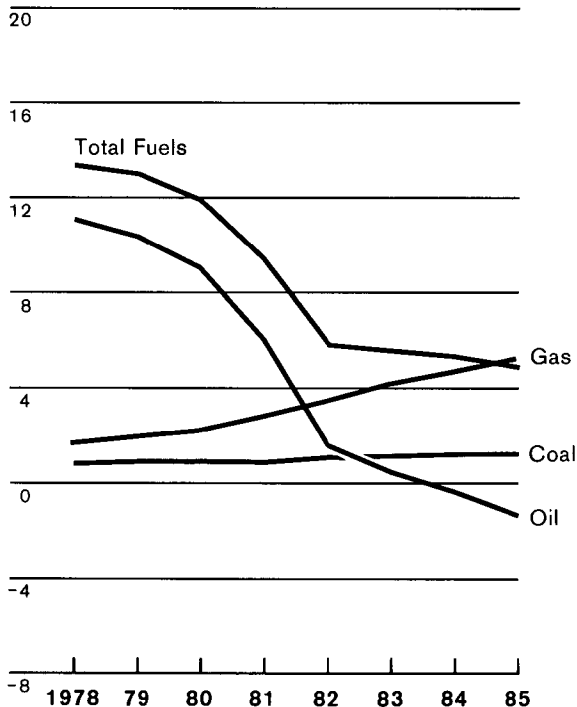
Unclassified

578664 3-79

**Baseline Scenario:
Projections of Net Soviet
Exports of Fuels to the World**

Figure 3

Billion 1977 US \$



Unclassified

578665 3-79

The regional patterns of fuels trade shown in figure 4 highlight the projected turnabout in hard currency trade that would result from pursuing current and announced policies for the 1980s. The net value of fuel exports to Eastern Europe just about doubles between 1978 and 1985, while net exports to the West fall from about a \$5 billion surplus to a \$4 billion deficit. After 1981, net exports to Communist countries are greater than net exports to the world, which means that net Soviet fuels trade with non-Communist countries is in deficit.

Hard Currency Trade and Finance

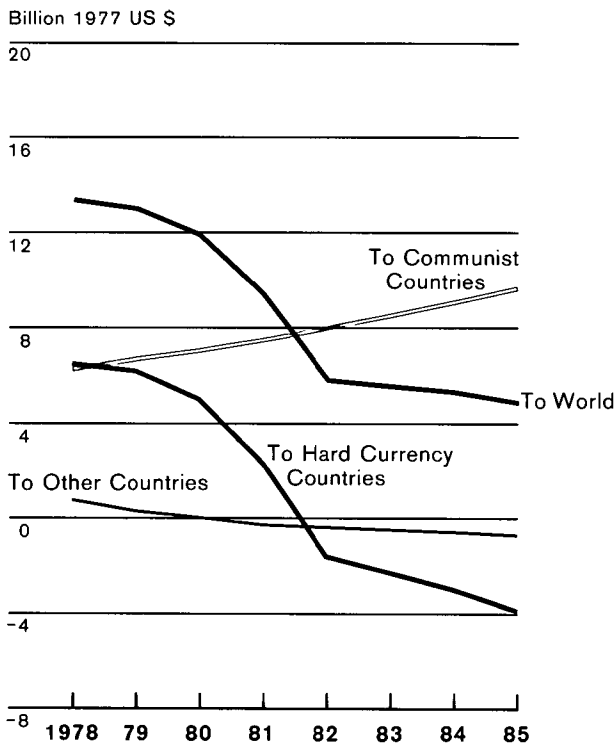
The projected shift in net oil trade with the West in the baseline simulation implies a major restructuring of hard currency trade over the next decade (figure 5). The slow fall in net oil exports to 1980 serves to break the growth in hard currency exports and, consequently, in affordable imports. Once the USSR is forced to

move from being a net oil exporter to being a net oil importer in the hard currency arena, growth in total exports and therefore total imports reflect the underlying trends in nonoil hard currency earnings and net credit availability. After 1982, oil imports from the West would compete directly with nonoil, nongrain imports for scarce foreign exchange. The only way to maintain these imports at the level assumed to be the acceptable minimum is to restrict oil imports, as the break in the net oil exports profile indicates.

Figure 5 also illustrates very clearly the projected conflict in the mid-1980s between oil and nonoil imports paid for in hard currency. After 1982, the Soviets could not afford to meet oil, grain, and nonoil, nongrain import requirements simultaneously. Trade-offs would have to be made, and our analysis assumes one way of making them. The trends in figure 5 suggest

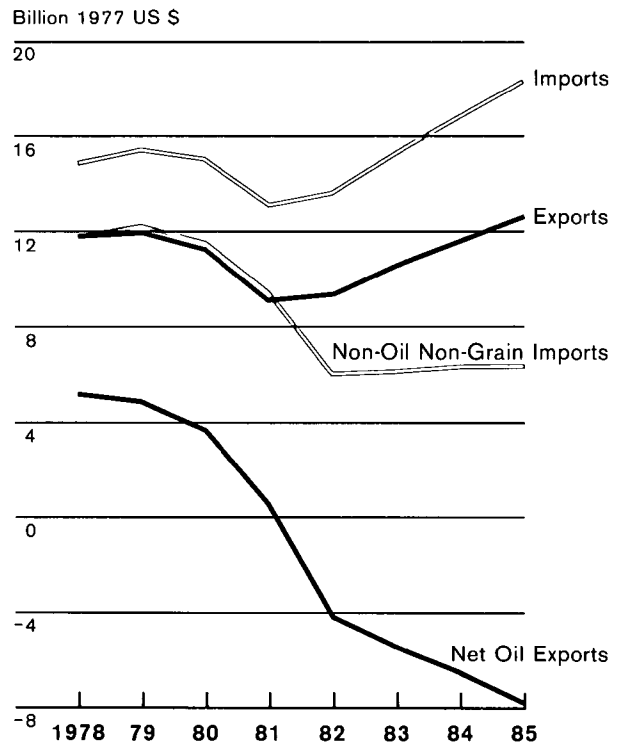
**Baseline Scenario:
Projections of Net Soviet
Exports of Fuels by Region**

Figure 4



**Baseline Scenario:
Trends in Hard Currency
Exports and Imports**

Figure 5



the volume of Soviet trade with hard currency countries is likely to grow little through the early 1980s. The longer term prospects for imports other than oil and grain look particularly dismal under the conditions of the simulation, since oil imports would displace about half of the current level of nongrain imports by 1985. Without our assumed floor on these other imports, the situation would be even worse.

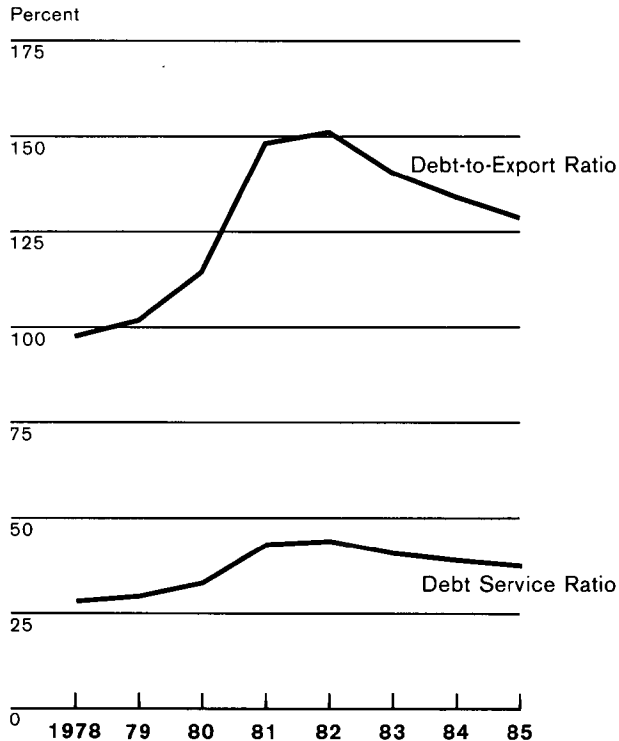
The baseline case in turn implies a slowly rising Soviet trade imbalance with the West. Through 1980, the hard currency trade deficit holds steady at about the current level. Total exports would be essentially unchanged because the fall in net oil exports of almost \$2 billion would just about offset the rise in nonoil exports allowed for by extrapolating recent trends. Imports would also be flat because flat export earnings mean little growth in import capacity. The situation would shift during the 1980s; export growth between 1980 and 1985 would then stem solely from sales of commodities other than oil. Although imports would fall in 1980 and 1981, subsequent import growth would reflect not only growth in nonoil export earnings but a growing share of credits in financing total Western imports.

The fall in oil exports leads to a sharp rise in the debt-service and debt-to-export ratios (figure 6).¹⁰ The rise in these ratios is unavoidable with total exports stable or rising slowly and Western debt projected to accumulate at a steady rate. The debt-service ratio would exceed 40 percent by the early 1980s as oil exports to the West fall. It falls back somewhat after that, but debt service would still represent more than one-third of commodity export earnings by 1985, about a 10-percentage-point rise above present levels. The debt-to-export ratio—the ratio of medium- and long-term debt to commodity exports to the West—shows a similar pattern with first a sharp rise in the later 1970s and early 1980s as debt rises even in the

¹⁰ The debt-service and debt-to-export ratios involved the use of data for Soviet export earnings in hard currency trade. In this paper, we have used only earnings in commodity trade, which excludes gold sales, hard currency arms sales, services, and transfers. Defining the ratios based on the more inclusive earnings concept would lead to lower values for both ratios in a given year. For example, in 1977, the debt-service ratio based only on commodity exports was 24 percent, while based on all hard currency earnings, it was 19 percent. For the debt ratio, comparable figures were 96 percent and 78 percent.

Baseline Scenario: Trends in the Debt-to-Export Ratio and Debt Service Ratio

Figure 6



Unclassified

578668 3-79

face of steady export earnings, and then a partial recovery to more reasonable levels by 1985 as the export earnings situation improves somewhat. Nonetheless, the level of hard currency debt would represent around 130 percent of annual merchandise exports by then, a full 30 percent above recent historical standards, but 20 percent below the peak in the early 1980s.

Alternative Scenarios Depicting Soviet Policy Options

The baseline simulation projects Soviet growth under a static set of policies and a static economic environment. Since Soviet policymakers are likely to consider policy shifts in the face of the economic difficulties we foresee, we can use the model to estimate the improvements that might result. Below we explore the

impacts that a selection of domestic and foreign trade policy options might have on the basic Soviet growth trends we project.

The GNP Costs of Oil Shortages

Growth under the baseline scenario leads to major dislocations by 1985 as the Soviet economy runs up against a combined oil - hard currency constraint. As the baseline simulation suggests, falling oil production after 1980 would eventually force the Soviet need for Western oil to unaffordable levels. By 1985, imports of manufactured goods from the developed West would be at minimum acceptable levels, with domestic oil deliveries still below nominal requirements. We can use our econometric model to estimate the economic costs of these constraints in terms of lost production.

The cost of this constraint can be viewed as the difference between the level GNP would have reached if nominal domestic oil requirements were fully met and the level projected under the constraint. Our calculations indicate that the assumed oil production profile costs the Soviets about 18 billion rubles or 3 percent of GNP by 1985 when compared with potential GNP under full oil allocations. The average annual rate of growth for 1981-85 would be 0.6 percentage point higher if the required allocations were achieved.

Conservation Required To Avoid Energy Shortfalls

One way to interpret this analysis is by hypothesizing the energy conservation required to eliminate the energy bottleneck. The description of energy demand in the model already reflects trends in improved efficiency that are embodied in historical data on production and consumption in the 1970s. Simulations of extraordinary conservation indicate that the USSR would have to improve energy efficiency slightly more than 1 percent per year during 1978-85 to allow full oil allocations and thus avoid hitting the hard currency and oil constraints.

The impacts of this extraordinary conservation case on key economic variables are given in table 3. Conservation reduces nominal domestic demand for all fuels. In so doing, it releases more coal and gas for export to hard currency countries and makes it possible to import more oil from the West to compensate for shortfalls in domestic production after 1982.

Greater conservation would of course raise potential GNP and growth even further but additional increments would be small. Conservation up to the point that prevents shortages has a big marginal impact. It would be "high powered" conservation because it raises capital utilization rates; the growth in active capital stock increases by an average of almost 2 percent per year during 1981-85 under the extraordinary conservation scenario. Conservation over and above the "high powered" conservation of 1 percent per annum would be "low-powered" conservation because it would simply free more fuels for export. To the extent these new exports helped finance capital imports they would lead to additional increments in production. But this process of capital formation through trade occurs with a lag and is also subject to leakage of import capacity into noncapital goods. Consequently, marginal impacts on output of conservation above 1 percent per year would be small through 1985.

This analysis also supports the position that the deceleration in Soviet growth we foresee for the next decade is much more than a reflection of difficulties with energy production. Removing the energy and subsequent hard currency constraints still leaves the projected average growth of GNP in 1981-85 at 3.1 percent per year, half of a percentage point below the comparable figure for 1976-80. The underlying causes of the growth slowdown are a reduction in the labor force growth rate, diminishing returns to a more slowly growing capital stock, and our projections of little growth in factor productivity. Energy problems simply serve to aggravate the underlying difficulties, by reducing the rates of capital utilization and accelerating downward trends already projected for the 1980s.

Other Domestic Policy Options

The Soviet leadership could certainly react to slower growth by changing ongoing policies—those focusing on the domestic economy and those centered in the foreign sector—and by instituting new ones. The key question is whether these options would have a significant impact on growth when compared with the baseline simulation.

Table 3**USSR: Projections Under Possible Domestic Policy Options**

Variables	Baseline Level	Variations Due to Policy Options ¹			
		Extraordinary Conservation	Manpower	Defense	Resource Reallocation
GNP					
AARG 1976-80 (percent)	3.6	0	0.1	0	Negl
AARG 1981-85 (percent)	2.5	0.6	0.1	Negl	0.2
Level 1980 (billion 1970 rubles)	554	0	2	0	-1
Level 1985 (billion 1970 rubles)	627	18	6	1	4
Active Capital Stock					
AARG 1976-80 (percent)	7.1	0	0	0	0.1
AARG 1981-85 (percent)	4.5	1.8	0.1	0.1	0.5
Employment					
AARG 1976-80 (percent)	1.3	0	0.2	0	0
AARG 1981-85 (percent)	1.1	0	0.2	0.1	0
Domestic Oil Use					
1980 (million metric tons)	458	-17	0	0	1
1985 (million metric tons)	464	52	4	1	29
Net Hard Currency Imports					
1980 (million metric tons)	34	17	1	0	4
1985 (million metric tons)	-59	-48	-1	1	-13
Net Oil Exports					
1980 (million metric tons)	132	17	1	0	4
1985 (million metric tons)	36	-48	-1	1	-13
Hard Currency Imports Excluding Fuels and Grain					
1980 (billion 1977 US \$)	11.6	3.8	0.2	0	0.9
1985 (billion 1977 US \$)	6.4	0	0	0	0
Debt-Service Ratio					
1980 (percent)	33	-8	Negl	0	-3
1985 (percent)	37	-13	-1	Negl	-5

¹ The difference between the value of the variable under the given policy option and its value in the baseline case.

To gauge the possible impacts of policy initiatives on growth possibilities through 1985, we resimulated Soviet growth under alternative policy conditions. We have chosen to examine the effects of three domestic policy options that would probably be open to the Soviets during this period:

- *Manpower.* Participation rates rise by one percentage point for the able-bodied population by 1985 and by 2 percentage points for pensioners.
- *Defense.* Military manpower is reduced by a half million men between 1980 and 1985. Nonpersonnel defense expenditures grow at about 2 percent per year, half their baseline rate.
- *Resource Reallocation.* The shares of new fixed investment and employment going to the energy sectors (oil, coal, gas, and electric power), chemicals, machinery, transportation and communication, construction, and industrial materials are increased gradually at the expense of investment in trade and services, consumer goods, housing, and employment in consumer goods.

We resimulated Soviet growth through 1985 with each option separately modifying the baseline conditions. By comparing the results of these simulations with the baseline case itself we can judge the potential change in key economic variables due solely to the particular option considered (table 3).

Manpower policies have the virtue of directly attacking a major growth bottleneck. Increments to the able-bodied population are established by longstanding demographic factors and respond only very slowly to policy changes. The participation rate can be more directly manipulated through incentives and legislation setting retirement ages. However, Soviet participation rates have been among the very highest in the world and leave little room for further increases. The gains assumed in the Manpower Case would—we suspect—require substantial changes in incentives and regulations. Yet, as table 3 shows, the economic gains probably would be modest. Soviet GNP and consumption would be about 1 percent higher by 1985, and growth rates would remain essentially unchanged from those achieved without the policy changes.

The *Defense Case* reflects more than a 10-percent reduction in military manpower and an equivalent 0.3-percent increase in the civilian labor force by 1985. It also reflects a halving of the growth in Soviet nonpersonnel defense spending. At the aggregate level, this defense slowdown has little perceptible impact on the Soviet economy. The extra increment in investment made possible by slower growth in military claims on the output of capital goods industries is very small, especially when compared with the total Soviet stock of productive capital. Therefore little extra production is available through 1985.

Of course, important sectors of the economy could still benefit from reduced competition with defense for key resources, and this could have greater potential for improving growth beyond 1985. Slower defense growth does have an immediate impact on the side of final demand as a portion of GNP is freed to meet civilian needs. Projections show that an increase in consumption of more than 1 percent would be possible by 1985 through the assumed reductions in the personnel and operating and maintenance portions of defense expenditures and the subsequent redirection of resources.

Reallocation of labor and investment resources is a policy option the Soviets certainly would consider. Reallocations of various kinds have been mentioned in the Soviet press, but no hard information exists on the changes, if any, that might be in the offing. The specific reallocations we simulated are therefore purely speculative, although they do reflect our judgment of what might be feasible given the time frame considered and the broad range of existing and emerging problem areas (tables 4 and 5).

For the reallocations we looked at, GNP growth in 1981-85 increases by about 0.2 percentage point (table 3), and GNP in 1985 is less than 1 percent higher. GNP is lower, however, in 1980 because the value of the output lost from the sectors losing resources is slightly more than the value gained from the sectors receiving extra resources. This is a reflection of two factors in the calculations: the estimated marginal products of capital and labor, and the value weights given output indexes for each sector.

Table 4

Billion 1970 rubles

**USSR: Assumed Pattern for
Reallocation of New Fixed Investment**

Sector	Estimated Change (1970-77)	Baseline Change (1977-85)	Assumed Change (1977-85)	Assumed Change – Baseline Change
Agriculture	10.67	7.09	7.09	0
Construction	2.25	1.46	1.96	0.50
Transportation and communication	6.32	3.94	4.35	0.41
Trade and services	4.81	5.35	2.67	-2.68
Industrial materials	2.68	2.66	3.99	1.33
Consumer goods	1.56	1.43	0.71	-0.72
Machinery	4.90	3.08	4.62	1.54
Chemicals	1.89	1.20	1.80	0.60
Gas	0.91	0.55	0.83	0.28
Oil	1.77	1.21	1.82	0.61
Coal	0.34	0.52	0.78	0.26
Power	0.93	1.12	1.40	0.28
Housing	3.67	4.82	2.41	-2.41
Other	0.59	0.54	0.54	0
Total	43.29	34.97	34.97	0

Table 5

Thousand Man Years

**USSR: Assumed Pattern for Reallocation
Of Nonagricultural Employment**

Sector	Estimated Change (1970-77)	Baseline Change (1977-85)	Assumed Change (1977-85)	Assumed Change – Baseline Change
Construction	1,803	1,791	1,941	150
Transportation and communication	1,815	1,841	1,991	150
Trade and services	6,625	6,023	6,023	0
Industrial materials	374	714	828	114
Consumer goods	504	1,412	504	-908
Machinery	2,616	2,445	2,745	300
Chemicals	287	307	350	43
Gas	1	5	8	3
Oil	10	45	70	25
Coal	-81	150	250	100
Power	93	117	140	23
Other	-58	0	0	0
Total	13,989	14,850	14,850	0

Table 6

**USSR: Model Projections
Under Possible Foreign Trade Options**

Variable	Baseline Level	Variations Due to Policy Options ¹			
		Oil Exports	Substitution	Western Imports	Debt Service
GNP					
AARG 1978-80 (percent)	3.6	0	0	0	0
AARG 1981-85 (percent)	2.5	0.3	Negl	0.1	Negl
Level 1980 (billion 1970 rubles)	554	0	0	0	0
Level 1985 (billion 1970 rubles)	627	8	2	4	1
Active Capital Stock					
AARG 1978-80 (percent)	7.1	0	0	0	0
AARG 1981-85 (percent)	4.5	0.8	0.2	0.4	0.1
Domestic Oil Use					
1980 (million metric tons)	458	0	0	0	0
1985 (million metric tons)	464	48	-12	22	3
Net Hard Currency Oil Exports					
1980 (million metric tons)	34	0	0	0	0
1985 (million metric tons)	-59	2	13	-22	-3
Net Oil Exports					
1980 (million metric tons)	132	0	0	0	0
1985 (million metric tons)	36	-48	13	-22	-3
Hard Currency Imports Excluding Fuels and Grain					
1980 (billion 1970 US \$)	11.6	0	0	0	0
1985 (billion 1970 US \$)	6.4	0	0	-3.1	0
Debt-Service Ratio					
1980 (percent)	33	0	0	0	0
1985 (percent)	37	Negl	6	Negl	-5

¹ The difference between the value of the variable under the given policy option and its value in the baseline case.

The marginal impacts of extra capital and labor in the energy sectors, especially oil, are low until the oil shortages occur late in the period, but are much higher afterwards. Domestic oil deliveries are up by 1985 in this case but are still not enough to meet nominal domestic requirements. The increased oil deliveries reflect both extra domestic production and additional hard currency imports financed by extra gas and coal exports. Because of increased fuel production, the debt-service ratio falls substantially as exports to the West of surplus coal and gas increase while debt is fixed by assumption at baseline levels.

Foreign Trade Options

The economic strains we project for the 1980s have a number of strong linkages to the foreign sector, especially to hard currency trade. We therefore analyzed the possible impacts of four policy options in the foreign trade area to see what additional flexibility these might provide the Soviets (table 6):

- *Oil Exports.* Oil exports to Eastern Europe fall from 95 million tons in 1980 to 45 million tons in 1985.

- *Substitution.* Half of the hard currency gas exports projected under baseline conditions are redirected to domestic use in place of oil, and domestic oil requirements are reduced accordingly.
- *Western Imports.* The floor on hard currency imports other than grain and oil is cut in half to 25 percent of the current import-GNP ratio.
- *Debt Service.* A trigger point of 35 percent is assumed for the debt-service ratio, which leads to restrictions on borrowing by the Soviets. In each year that the ratio exceeds 35 percent, actual new credit drawings are only one-half the corresponding levels in the baseline case.

Lower oil exports to Eastern Europe could have a strong impact on the Soviet economy because capital utilization rates would be immediately raised when oil is in short supply. This would add more than 1 percent to GNP and consumption by 1985 compared with a baseline projection and would postpone the emergence of domestic oil shortages for a couple of years. By assumption, all oil diverted from export to Eastern Europe is consumed domestically, not exported to the West, unless the nominal domestic demand for oil is fully met. Therefore, this policy's impact on hard currency trade is negligible.

Substitution of gas for oil holds some attraction for the USSR since it is expected to be a major gas producer with a large domestic surplus over the next decade. With the export value of a standard fuel unit of gas projected to be less than that of oil through 1985,¹¹ there is an advantage in substituting gas for oil in domestic use. Diversion of half the hard currency gas exports of the baseline case to domestic use would reduce domestic oil requirements by an equivalent amount in energy terms. Since the oil saved would be worth more in trade than the gas lost to export, there is a net gain to the economy through this substitution. But, the boost to GNP of 2 billion rubles is quite modest, especially considering that the analysis does

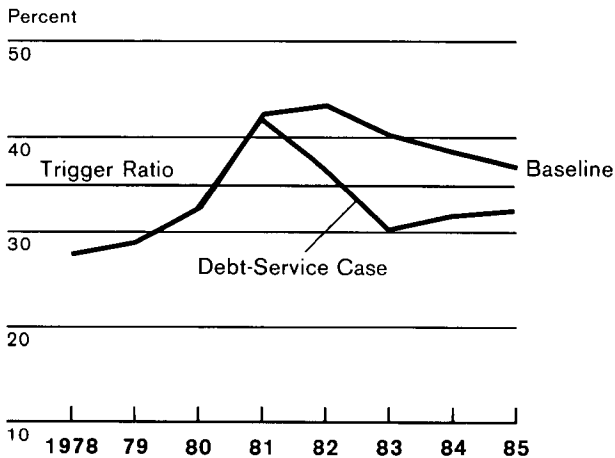
not account for the cost of converting from oil to gas in specific industries. Moreover, the debt-service ratio would rise substantially as export earnings fell with increased domestic use of gas.

Cutting *hard currency imports* other than grain and oil would be a bonus for the Soviet economy in 1978-85, adding as much as 4 billion rubles to GNP by 1985. This gain comes from the additional oil imports—22 million tons in 1985—that can be obtained by diverting scarce hard currency import capacity away from other commodities. As long as oil is in short supply, this substitution has a large immediate impact on production. At issue here is the trade-off between more output now and more output in the future. The drop of almost \$3 billion in imports from the West by 1985 would represent a severe blow to longer term growth prospects in crucial sectors like oil, chemicals, and machinery—where imported capital goods are a significant share of new, high technology investment. The post-1985 economic consequences of sacrificing imports of Western capital goods in favor of more oil and therefore more domestic production during 1978-85 could be substantial indeed, but are not accounted for in our analysis.

Moscow's attitude toward the Soviet *debt-service ratio* reflects its desire to borrow on favorable terms and to convey an image of economic strength to the rest of the world. High debt-service ratios are generally viewed by potential lenders as indicators of high risk and therefore lead to higher costs of borrowing funds to finance Western imports. Our simulation of a simple 35-percent trigger rule shows that it would have little impact on Soviet GNP. It would, however, have a significant impact on the Soviet hard currency trade picture. In part, because of the fall in oil exports, the debt-service ratio soars above 40 percent in 1981, triggering two successive years of credit restraint (figure 7). This is more than sufficient to send the debt-service ratio below the 35-percent trigger point by 1983 and to keep it in the vicinity of 30 percent, 5 percent below the baseline level by 1985.

¹¹ This is consistent with recent unit value data. If the relative price between gas and oil at the point of use is proportional to energy content, then the relative price in terms of Soviet f.o.b. prices must shift against gas, because it is more expensive to transport than oil. The observed trends in unit value data, which are based on Soviet f.o.b. prices, may reflect this relationship.

Debt Service Case: Debt Service Ratio When Debt Service Trigger is Applied Figure 7



Unclassified

578669 3-79

The cost of this debt-service control is the hard currency imports forgone during the 1981-85 period. Since this amounts to only about 5 percent of the projected hard currency imports for those five years, the Soviets would be in a position to control potential debt servicing problems while maintaining a flow of most crucial imports from the West. Nonetheless, the decision to cut back on Western credits would not be an easy one under the multitude of economic pressures that are likely to coexist in the early 1980s, and the impact on the consumer or certain investment programs could be considerable.

Sensitivity of Model Results to External Contingencies

Our baseline case assumed a rather stable economic environment in the form of a straightforward extrapolation of recent trends. Shifts in the assumed economic environment would of course change our projections of Soviet growth. From the standpoint of this study, however, the interesting issue is how sensitive our baseline projections are to possible changes in the conditions that we have assumed.

We decided to examine the effects of six contingent events—three involving the domestic economy and three concerned with foreign trade—by resimulating Soviet growth under changed underlying conditions.¹²

1. *Flat Oil.* Soviet oil production peaks at 590 million tons in 1980 and holds flat at this level through 1985.

2. *High Oil.* Soviet oil production peaks at 600 million tons in 1981-82 but falls to the baseline level of 500 million tons in 1985.

3. *Low Oil.* Soviet oil production peaks at 590 million tons in 1980 but falls to 400 million tons in 1985.

4. *Lower Western Growth.* Soviet nonfuel exports to the West grow at only one-half the baseline rate, reflecting slower growth in the developed West and, hence, lower levels of Western demand for Soviet exports.

5. *Higher Oil Prices.* World oil prices in the 1980s rise at an annual rate 5 percent faster than under the baseline conditions, implying a tighter world oil market during this period.

6. *Credit Ceiling.* Baseline credits are taken whenever they fall below a ceiling consisting of 70 percent of Soviet imports of hard currency capital goods plus a smaller amount of general purpose credits. Ceiling credits are taken whenever baseline credits are higher.

The results of these six simulations are compared with the baseline simulation in table 7.

¹² Soviet agriculture is an additional source of major uncertainty in our analysis. All of the projections in this study are based on normal weather conditions and therefore normal performance in agriculture. Simulations of other performance patterns in agriculture—a three-year cycle composed of good, bad, and normal years; a succession of bad years in the early 1980s; a succession of good years in the early 1980s—had little perceptible effect on growth trends in the major economic aggregates. While the potential impacts on earnings in hard currency trade and finance were substantial in certain years, the overall hard currency trade situation appeared to be manageable.

Table 7**USSR: Model Projections
Under Major Contingencies**

Variable	Baseline Level	Variations Due to Domestic Contingencies ¹			Variations Due to Foreign Trade Contingencies ¹		
		Flat Oil	High Oil	Low Oil	Lower Western Growth	Higher Oil Prices	Credit Ceiling
GNP							
AARG 1976-80 (percent)	3.6	0	0	0	0	0	0
AARG 1981-85 (percent)	2.5	0.5	0	-0.6	-0.1	-0.1	Negl
Level 1980 (billion 1970 rubles)	554	0	0	0	0	0	0
Level 1985 (billion 1970 rubles)	627	17	0	-19	-3	-2	-1
Active Capital Stock							
AARG 1976-80 (percent)	7.1	0	0	0	0	0	0
AARG 1981-85 (percent)	4.5	1.5	0.	-1.7	-0.3	-0.2	-0.1
Domestic Oil Use							
1980 (million metric tons)	458	0	0	0	0	0	0
1985 (million metric tons)	464	88	0	-96	-17	-11	-6
Net Hard Currency Oil Exports							
1980 (million metric tons)	34	0	0	0	0	0	0
1985 (million metric tons)	-59	3	1	-4	17	11	6
Net Oil Exports							
1980 (million metric tons)	132	0	0	0	0	0	0
1985 (million metric tons)	36	3	1	-4	17	11	6
Hard Currency Imports Other Than Fuels and Grain							
1980 (billion 1977 US \$)	11.6	0	0	0	-0.7	0	0
1985 (billion 1977 US \$)	6.4	0	0	0	0	0	0
Debt-Service Ratio							
1980 (percent)	33	0	0	0	2	0	0
1985 (percent)	37	1	0	Negl	8	0	-8

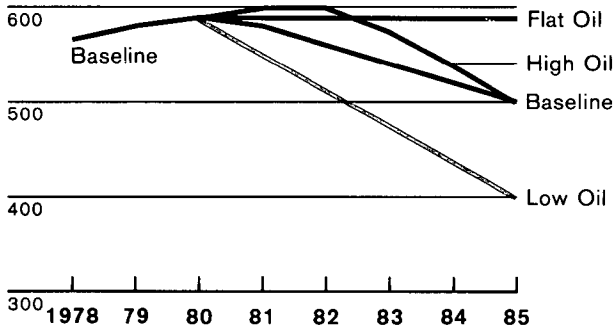
¹ The difference between the value of the variable under the given contingency and its value in the baseline case.

Alternative Oil Production Profiles

Figure 8

Million Metric Tons

700



Unclassified

578670 3-79

The plausible range of Soviet oil production over the next decade is wide and this uncertainty naturally has an important impact on the range of possible Soviet economic performance to 1985. Figure 8 shows four alternative production profiles: high oil from our 1977 study of Soviet oil prospects,¹³ the baseline assumption reflecting perhaps a most likely situation under present conditions, flat oil as an extreme possibility on the high side, and low oil as an extreme on the low side.¹⁴

Flat oil production between 1980 and 1985 is, we believe, not in the cards. However, if it were to occur and all the extra oil went to meet domestic needs, our simulations indicate that energy would not be a constraint on Soviet growth during the period. Both the rate of GNP growth in 1981-85 of 3 percent and the 1985 GNP of more than 640 billion rubles are both consistent with the potential performance we estimated earlier in the absence of an energy constraint. Even in 1985, almost 100 percent of domestic energy demand can be met. This means that capital utilization rates could be held at or close to 100 percent during the

¹³ *Prospects for Soviet Oil Production.*

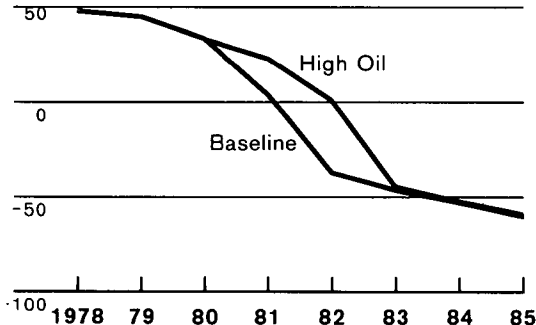
¹⁴ The production figure of 400 million tons in 1985 is the low end of the range estimated in our 1977 study.

High Oil Case: Net Exports of Oil to Hard Currency Countries

Figure 9

Million Metric Tons

100



Unclassified

578671 3-79

full period, and the growth rate for the active capital stock would rise an average of 1.5 percentage points. Hard currency imports would nudge the acceptable floor by 1985, but would be kept above the assumed minimum level in all other years. Nonetheless, flat oil production itself would in no way reverse the deterioration in growth prospects in general and hard currency trade in particular that our simulations clearly indicate.

The effects of the *high oil* scenario would be primarily to delay the inevitable and to provide an additional year or two for adjustment. But the impacts on the aggregate economy by 1985 would be minimal. High oil would allow substantial hard currency oil exports through 1981 and would delay the need to import oil from the West until 1983 (figure 9). This means several extra years of high imports of Western capital goods and full domestic oil allocations. With oil production assumed to drop eventually to the same 500-million-ton level as in the baseline case, though, the effects on GNP in 1985 would be very small.

The *low oil* case, like the flat oil case, is not likely to occur. However, if recovery rates continue to fall and peak production of Samotlor is not held for more than

a couple years, Soviet oil production could indeed approach the levels of the low oil case. Simulation results show that the impacts on the Soviet economy would be severe. Average growth in 1981-85 would fall more than one-half a percentage point, with even more serious reductions on an annual basis in the later years. With oil production down, little additional import capacity available, and export commitments to Eastern Europe fully met, domestic oil use would have to fall by more than 20 percent. The Soviets would certainly take steps to avoid such dire consequences if oil production as low as 400 million tons in 1985 seemed a real possibility. The mix of reactions—resource reallocations, export reduction, greater conservation, larger imports—can be only conjectural now.

Slower Western growth means that the Soviet hard currency import capacity would grow more slowly. Oil imports during the 1980s would have to be reduced accordingly and this would have an adverse effect on capital utilization. Oil imports from the West in 1985 fall from 59 million tons to 42 million tons in the face of a more binding hard currency shortage. During years like 1980, when energy is not a constraint on trade, reduced exports to the West would lead to a substantial fall in affordable nongrain imports from the West. Lower hard currency exports also mean higher debt-service ratios; a peak figure of more than 50 percent is reached in the early 1980s. Even with reduced capital imports and lower domestic oil use in the later years, slower Western growth has only a small effect on realizable levels and rates of growth of GNP.

The effect of *higher oil prices* (in real terms) on Soviet growth would shift as the Soviets moved from being a net exporter to being a projected net importer on a hard currency basis. In 1980, when the USSR is still a major net oil exporter to all regions, higher oil prices increase foreign exchange earnings and ultimately hard currency imports. By 1985, the Soviets are projected to be substantial importers of Western oil. As a result, higher prices for imported oil exacerbate the projected hard currency problems and lead to a smaller import volume in the face of a floor on other hard currency imports. Again, the aggregate trend effects on such broad aggregates as GNP and consumption would be small through 1985.

The possibility of a *credit ceiling* exists because most Western lending is correlated with Soviet imports of Western capital goods. The model shows that the Soviet capacity to import Western capital goods is likely to fall in the early 1980s as domestic energy needs restrain the growth in export earnings. We assume, therefore, a coincident fall in the availability of Western credits at terms acceptable to the USSR.¹⁵

Simulation of such a credit ceiling leads to a projection of new credit drawings that is very different from the baseline case (figure 10). Through 1981, credit levels assumed available in the baseline case are consistent with the credit ceiling. After 1981, they are substantially above the level that would correspond to the projected volume of hard currency capital imports, and actual drawings are constrained to the lower ceiling figure. These lower drawings mean lower debt and debt service during the last few years of the period (figure 11). The debt-service ratio falls below 30 percent by 1985, a full 8-percentage-point improvement over the baseline case. The credit ceiling would reduce potential GNP in 1985 only slightly—a result of somewhat lower affordable oil imports and therefore lower capital utilization rates in the 1982-85 period.

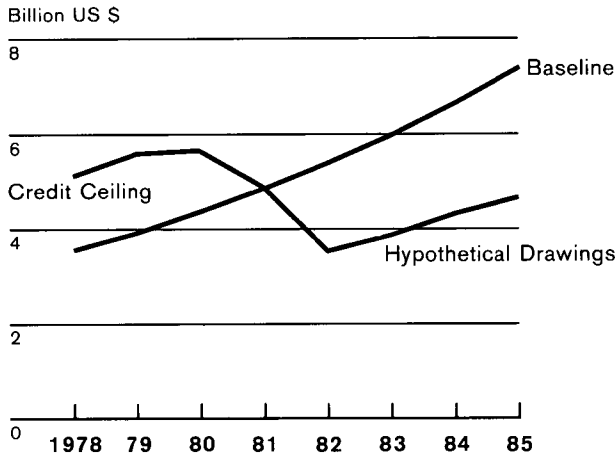
Model Simulations Involving a Mix Of Options and Contingencies

It is easier to understand the possible effects of policy shifts and contingent events by examining them individually as we have done above. However, isolated changes are not realistic; Soviet growth prospects are instead a complex reflection of a mix of policies and contingent events operating simultaneously. The final step in our analysis is to examine Soviet growth possibilities under a mix of options and contingencies. The econometric model is particularly useful in this kind of analysis, for it provides an integrated analytical framework for looking at the interactions of many simultaneous events, whose effects would otherwise be considered separately.

¹⁵ This implies that a credit constraint would exist on the supply side because of the particular structure of imports projected for the 1980s. Alternatively, the Soviets could voluntarily ration credit themselves; this may already be reflected in present Soviet behavior. This credit constraint on the demand side would have the same analytical implications as an equivalent constraint on the supply side, and the distinctions become somewhat arbitrary.

Credit Ceiling Case: New Credit Drawings

Figure 10



Unclassified

578672 3-79

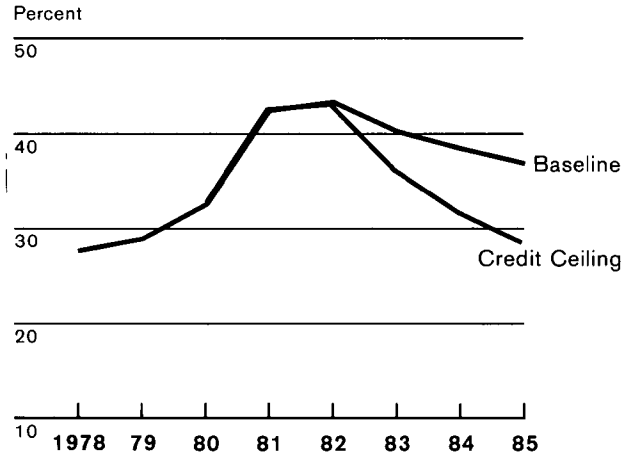
We have looked at Soviet growth prospects under three separate sets of conditions:

- **Composite Options.** This case begins with the baseline economic environment but assumes the Soviets exercise (a) the *manpower option* because it is the most direct attack on the labor supply problem, (b) the *oil exports option* because cutting oil exports to Eastern Europe is the most feasible way of realizing short-term gains in oil supplies, (c) the *debt-service option* because of the Soviet history of a conservative approach to trade finance, and (d) the *resource reallocation option* because it has beneficial effects on energy and investment in both the short and long term. The other options were taken to be less attractive or less feasible for a variety of reasons. Lower defense growth gave little aggregate gain by 1985 and would face strong political opposition; the floor on Western imports in the baseline case already implies severe restrictions on even high-priority imports; gas substitution would entail considerable conversion costs; and there is little technological or organizational basis for expecting extraordinary conservation.

- **Composite Contingencies.** This case incorporates the base case assumptions except that it assumes that the three foreign trade contingencies—lower Western growth, higher oil prices, and lower hard currency credits—do occur. High oil was considered the most

Credit Ceiling Case: Debt Service Ratio

Figure 11



Unclassified

578673 3-79

likely of the alternative oil production profiles and was also included.

- **Composite Projection.** This case combines the four policy options and the four contingencies into a composite view of Soviet growth prospects that can be compared with the baseline simulation.

The results of these three composite simulations are compared with the baseline case in table 8 and figures 12 to 15 to indicate the sensitivity of the model's forecast of Soviet economic performance to some fairly complicated mixes of assumptions.

The *combined options* would add about 3 percent to both GNP and consumption by 1985 and around one-half a percentage point to the average rate of growth in the first half of the 1980s. As we showed earlier, much of this gain comes from reduced oil exports to Eastern Europe. In fact, this case indicates that the Soviets would be net importers of oil by 1985 with increased domestic use and lower exports to Eastern Europe. This simulation implies more of a Soviet reluctance to dip aggressively into Western credit markets, leading naturally to a substantial decrease—to 30 percent—in the debt-service ratio by 1985.

Table 8**USSR: Alternative Views of
Growth Prospects for 1978-85**

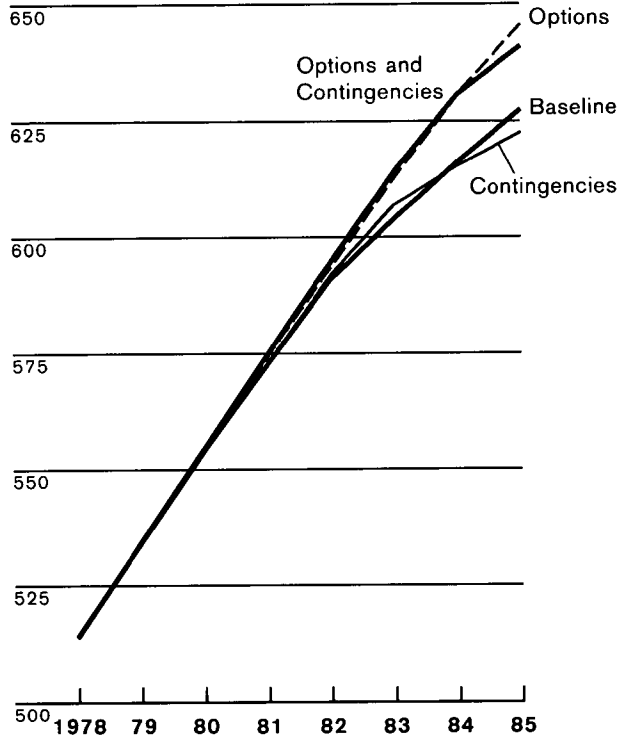
Variables	Baseline Level	Variations ¹		
		Composite Options	Composite Contingencies	Composite Projection
GNP				
AARG 1976-80 (percent)	3.6	Negl	0	Negl
AARG 1981-85 (percent)	2.5	0.6	-0.2	0.4
Level 1980 (billion 1970 rubles)	554	1	0	1
Level 1985 (billion 1970 rubles)	627	18	-5	14
Active Capital Stock				
AARG 1976-80 (percent)	7.1	0.1	0	0.1
AARG 1981-85 (percent)	4.5	1.4	-0.4	1.0
Employment				
AARG 1976-80 (percent)	1.3	0.2	0	0.2
AARG 1981-85 (percent)	1.1	0.2	0	0.2
Domestic Oil Use				
1980 (million metric tons)	458	1	0	5
1985 (million metric tons)	464	84	-28	56
Net Hard Currency Oil Exports				
1980 (million metric tons)	34	5	0	5
1985 (million metric tons)	-59	-16	29	13
Net Oil Exports				
1980 (million metric tons)	132	5	0	5
1985 (million metric tons)	36	-66	29	-37
Hard Currency Imports Other Than Fuels and Grain				
1980 (billion 1977 US \$)	11.6	1.1	-0.7	0.4
1985 (billion 1977 US \$)	6.4	0	0	0
Debt-Service Ratio				
1980 (percent)	33	-3	2	-2
1985 (percent)	37	-7	-6	-3

¹ The difference between the value of the variable under the given policy option or contingency and its value in the baseline case.

GNP: Comparative Projections Through 1985

Figure 12

Billion 1970 Rubles



Unclassified

578674 3-79

On the other hand, the *combined contingencies* have a much smaller negative effect on growth, except in the hard currency trade area where slower growth of exports to the West and a credit ceiling cause a substantial fall in affordable imports and a decrease of 6 percent in the debt-service ratio. The contingencies would also imply a sharp increase in net oil exports because of lower affordable imports of Western oil.

The combined effects of the policy options and assumed contingencies—given by the *Composite Projection*—are still strongly positive. They suggest that the Soviets could maintain growth at about 3 percent per year during 1981-85 and reach a GNP of about 640 billion rubles by 1985. Under the conditions of our analysis, this would also imply some improvement over the baseline case in the international financial position of the Soviet Union, as the lower debt-service ratio indicates. Under this composite view, Soviet oil trade

would be in overall balance by 1985, with exports to Communist countries essentially offset by imports from the West.

These observations are amplified in the following charts showing the projected time paths for important variables:

- *GNP* (figure 12). The projections are sensitive to the assumed conditions only toward the end of the 1978-85 period when the oil and trade constraints come into play. The effects of the policy options strongly dominate those of the contingencies and result in a range for expected Soviet GNP in 1985 of about 620-640 billion rubles.

- *Domestic Oil Use* (figure 13). There is a year or two swing in the expected break in the trend of domestic oil use, depending on assumptions. Eventually, though, oil allocations must be held below nominal requirements under all conditions we examined. The range of possible domestic oil use in 1985 is considerable—about 100 million tons or almost 20 percent of the baseline case—because the shifting analytical assumptions have strong impacts on net oil exports. However, the difference between the baseline case and the Composite Projection is only about 10 percent.

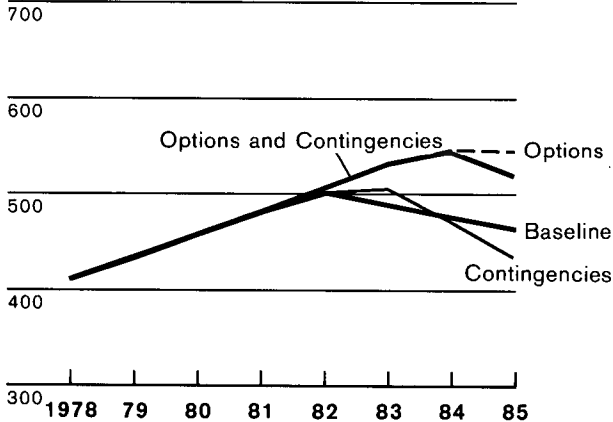
- *Net Hard Currency Oil Exports* (figure 14). The timing of the Soviet shift from a net oil export to a net oil import position with the West is somewhat sensitive to the particular conditions analyzed. The option of lower exports to Eastern Europe and the contingency of high oil both stretch out the period of potential oil surplus and together delay the need to import Western oil to 1983 or later. But this shift seems inevitable by 1985, given the Soviet oil production profile underlying the analysis.

- *Hard Currency Debt-Service Ratio* (figure 15). The debt-service ratio seems destined to rise in the late 1970s and early 1980s, primarily due to the expected slowdown in growth of Soviet export earnings in the West. The peak figure could exceed 40 percent, especially if the drop-off in oil exports from one year to the next is particularly severe as it is in the Composite Projection in 1983. The simulations other than the baseline scenario all involve a form of credit restraint—either voluntary or involuntary. Restraint of

Domestic Oil Use: Comparative Projections Through 1985

Figure 13

Million Metric Tons



Unclassified

578675 3-79

the kind simulated effectively corrects any debt-servicing problems implied by the debt-service ratio and, under all three conditions, brings the figure back into the 30-percent range by 1985.

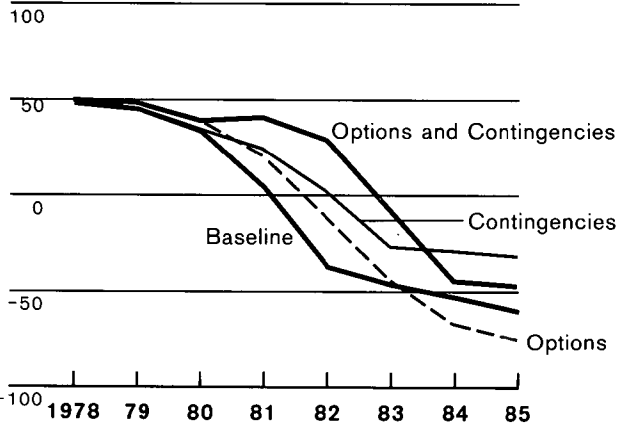
Some General Observations

Any analysis of the prospects for Soviet economic growth is very speculative. This uncertainty is simply a reflection of the many unknown events and reactions—some under the control of Soviet policymakers and some not—that are likely to have a profound influence on growth over the next decade. The analysis in this paper, especially in the preceding section, suggests a way of looking at some of these uncertainties in a consistent and integrated manner. While the likelihood of the sets of events and policy decisions we have analyzed cannot be established precisely, measures of their potential quantitative impacts on the Soviet economy can be calculated. From this analytical process emerges, then, not a single forecast of Soviet economic growth, but a range of possible performance depending on specific conditions. This range is itself a measure of the degree of uncertainty inherent in the analysis, and serves as a preferred guided for appraising the development of Soviet economic potential into the next decade.

Net Hard Currency Oil Exports: Comparative Projections Through 1985

Figure 14

Million Metric Tons



Unclassified

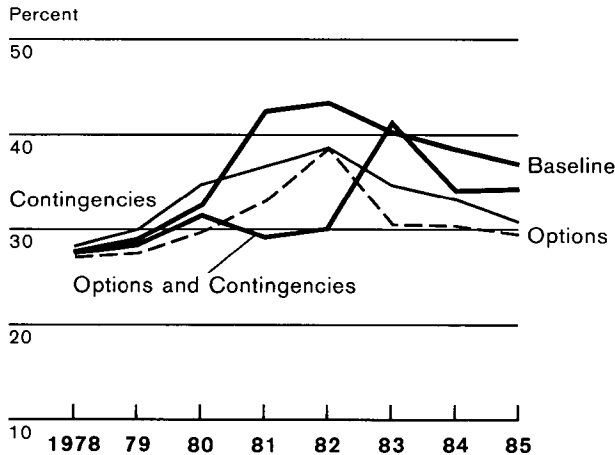
578676 3-79

The econometric model is a central tool in assessing the uncertainties in Soviet growth possibilities and sizing the possible effects of policy options and contingent events into the 1980s. In particular, the model simulations suggest that:

- Falling oil production could lead to an accumulated 3-percent loss in GNP by 1985 compared to potential GNP without an oil constraint.
- Resource reallocations on the scale of the recent past are not likely solutions to the basic problems underlying future Soviet growth.
- Drastic reductions in oil exports to Eastern Europe may be the only effective way to contain the potential domestic damages of energy shortages likely to emerge by 1985.
- The USSR will become a net importer of Western oil by 1985, unless prospects for domestic oil production move sharply upward over the next few years or exports to Eastern Europe drop substantially.

Hard Currency Debt Service Ratio: Comparative Projections Through 1985

Figure 15



Since the problems we foresee become acute only as 1985 approaches, it is unlikely that these trends will be reversed by the late 1980s. Prospects after 1985 depend on such issues as the strength and timing of improvements in demographic factors affecting the supply of labor, the institution of effective policies to improve the use of investment resources, and the discovery and development of new oil reserves. Even if developments in these areas in the next few years prove favorable, their full impacts will not be felt until the late 1980s and early 1990s. The basic shape of Soviet economic growth over the next decade seems already set by events currently being played out both within and outside the USSR.

Unclassified

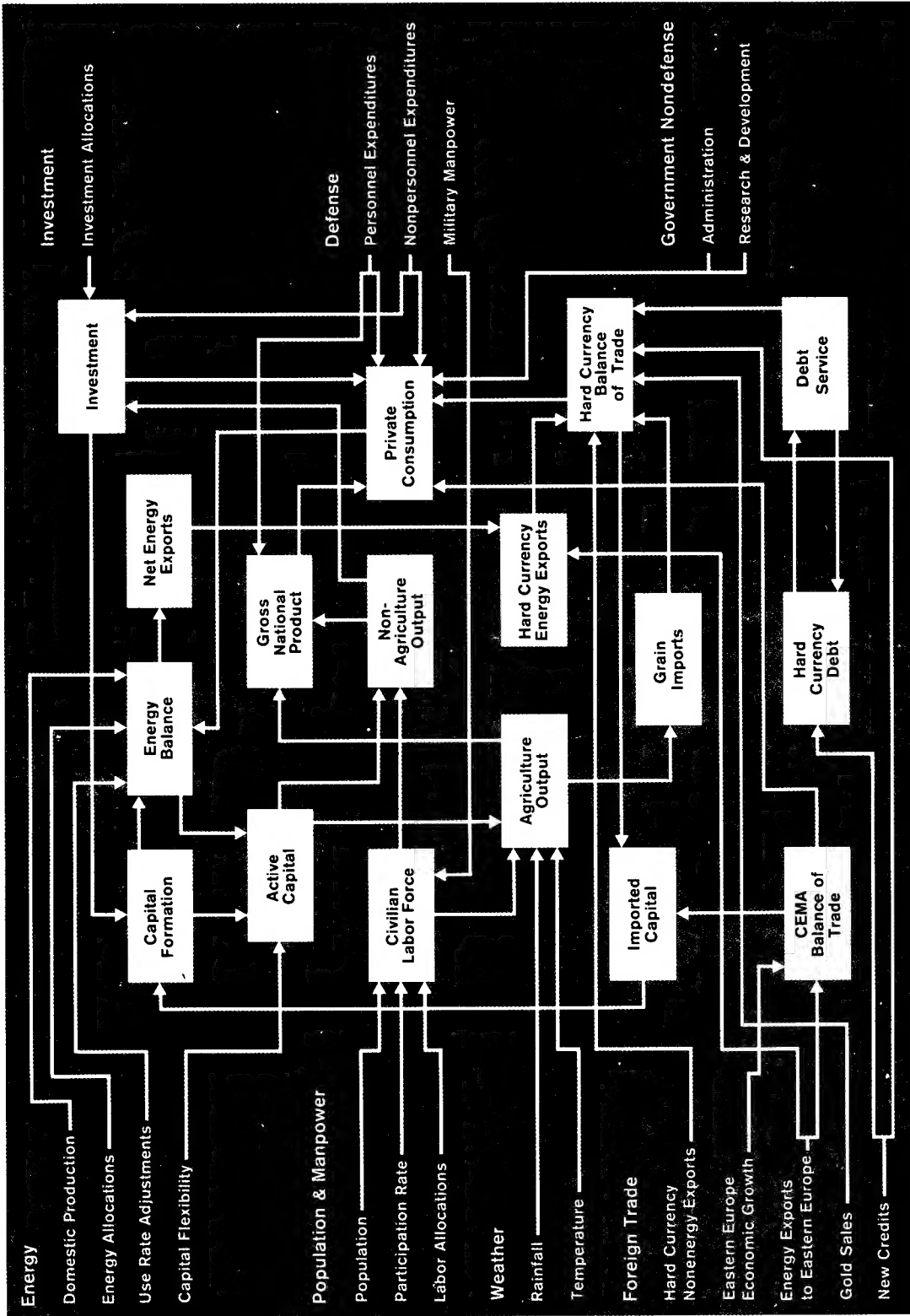
578677 3-79

- Soviet hard currency imports other than grain and eventually oil are likely to fall in real terms by 1985 as hard currency export earnings and credits become increasingly unable to meet all trade financing requirements.

Considering both Soviet policy options and contingent events that are likely to influence Soviet growth, the range of our projections suggests that the Soviets have surprisingly little economic maneuverability. The model simulations indicate that they will be hard pressed to maintain growth at an average of 3 percent a year in the first half of the next decade; growth could fall nearer to the 2-percent range if the necessary policy adjustments are not taken. The assumptions we made in several key areas—labor productivity holding up in the face of energy shortages affecting the use of capital, full substitutability of fuels at the margin, smooth adjustment to policy shifts, the absence of short-term bottlenecks—were very optimistic from the Soviet standpoint. Therefore, actual growth is more likely to be even below, rather than above, these projections.

Figure A-1

General Flow Diagram of the Soviet Economic Model



Unclassified

578351 3/79

Appendix

A Summary of the Econometric Model Of the Soviet Economy

Our model of the Soviet economy reflects the fundamental nature of a centrally planned economy (CPE).¹ A CPE is supply oriented in both economic activity and economic institutions. The supply of labor and stock of productive capital are more or less fully employed in a range of productive activities determined by labor and investment allocation policies. Output is divided among competing uses according to both availabilities and relative priorities, with private consumption generally taken as the residual claimant.

The general structure of the Soviet model is shown in figure A1. The model can be used to project five groups of economic variables—the model's endogenous variables:

- **Production.** In this group are the outputs of each producing sector measured in terms of value added. It also includes private consumption as the residual claimant on output once deductions are made for public consumption, investment and foreign trade.
- **Capital Formation.** The model computes investment in each producing sector plus housing, and projects the capital stock in each sector from knowledge of past investment levels.
- **Employment.** This involves projections of the labor force and ultimately the level of employment in each producing sector.
- **Energy.** The model calculates an energy balance between domestic production, producing sector demands, final demand and net exports. It also estimates effective or active capital stock.
- **Foreign Trade.** In this group are variables describing Soviet trade with communist countries and with the West. It also includes measures of hard currency debt and debt service.

¹ The model is described in detail in *SOVISM: A Model of the Soviet Economy*, ER 79-10001, February 1979, Unclassified.

All projections from the model are conditioned by assumptions regarding six groups of external or exogenous variables:

- **Energy.** These variables include projected outputs of the energy sectors, the energy allocation policy, and the capital flexibilities for each producing sector.
- **Population and Manpower.** The pattern of population growth, participation rates and the structure of labor allocations are inputs to the model.
- **Weather.** Indexes of temperature and rainfall are used to calculate agricultural production.
- **Foreign Trade.** Nonfuel exports to the West depend primarily on external economic conditions and are an input to the model. Energy exports to Eastern Europe are considered a function of both political and economic factors and are therefore set outside the model. Gold sales also fall in this category.
- **Investment.** The allocation of available investment resources among competing uses is set by policy decision.
- **Government Spending.** This group includes the levels of personnel and nonpersonnel expenditures for defense and the shares of administration and research and development in GNP.

Two hundred and seven equations connect a like number of endogenous variables with 67 exogenous variables. Thirty-five of the equations involve econometric estimates of parameters. The other 172 either use nonstatistical procedures to estimate structural parameters or are accounting identities.

The functional relationships among model variables shown in condensed form in the figure A2 define the variables and parameters appearing in these equations. These linkages can be described as follows:

- **Production.** There are constant-returns-to-scale, Cobb-Douglas production functions for each non-energy producing sector (equation 1).² Value added in the energy sectors is scaled from gross output, which is exogenous for these sectors. GNP is obtained by summing value added in the 13 producing sectors (equation 2).
- **Consumption.** Government expenditures (equation 3) include exogenous defense spending and an endogenous component scaled from the level of GNP. Private consumption (equation 4) is calculated as the residual claimant of GNP.
- **Investment.** The supply of capital goods available for domestic investment is the residual of deliveries of machinery and construction output to final demand, after deductions are made for deliveries to defense, exports, consumption, and capital repair (equation 5). Equation 6 distributes new fixed investment to each producing sector and housing with shares set outside the model.
- **Capital Formation.** Net additions to the productive capital stock are estimated from past investment and assumed depreciation rates (equation 7). Identity equations then link capital stock to the previous year's capital stock and net capital formation (equation 8).
- **Employment.** The labor force is estimated from the able-bodied population and participation rates (equation 9). Total employment (equation 10) depends on the labor force and employment rates, and sector employment levels (equation 11) follow from the total employment and labor allocation shares.
- **Energy.** Equation 12 estimates nominal demands for oil, gas, coal, and electric power in each consuming sector from the capital stock and energy-use coefficients tied to the capital stock of the given sector. Actual deliveries (equation 13) are determined by a combination of nominal requirements and assumed allocation policy. Equation 14 calculates domestic energy residuals by subtracting domestic deliveries from gross domestic output. Depending on its sign, the residual indicates either a capacity for next exports or a need for net imports. Equation 15 calculates the fraction of sector energy requirements, in terms of standard fuel units, actually met by deliveries. Together with an elasticity of active capital with respect to energy input,³ this fraction determines the rate of capital utilization and thus the active capital stock in each sector (equation 16). Any shortfall in meeting nominal domestic requirements for energy leads to a reduction in capital utilization. The degree of reduction for a given shortfall varies by sector depending on the value of the capital elasticity and the relative contribution of the type of energy in short supply to the particular sector's energy consumption.
- **Foreign Trade.** Net exports of fuels to hard currency countries (equation 17) are the difference between the domestic energy residuals and exogenous net exports to Communist and other countries. Net exports of fuels to hard currency countries, along with other variables that represent sources of hard currency, feed into a calculation of the hard currency import capacity (equation 18), which in turn drives imports from hard currency countries (equation 19). If these imports fall below a specified floor, domestic energy use is reduced by reducing e_{ij} and energy exports are increased (or energy imports are reduced) until sufficient import capacity exists to meet the import minimum.

² Statistical estimation with a conventional Hicks-neutral specification of disembodied technological change proved unsuccessful. The constant-returns-to-scale assumption, made in order to obtain statistically acceptable results, picks up some of the technological change effect because actual returns-to-scale are probably below unity in most sectors. The absence of a disembodied technology term on the sector level is consistent with Soviet development, which has been characterized more by extensive rather than intensive application of technology. This would be reflected in the general rise of the capital stock in each sector, not in a separate trend of improvement in total factor productivity.

³ This elasticity is the percentage reduction in capital utilization that follows if energy deliveries fall one percent below nominal sector demand.

Figure A2

Condensed Model Structure

A. Equations

Production

$$1. X_i = f(\bar{K}_i, N_i)$$

$$2. GNP = \sum_i X_i$$

Consumption

$$3. G = t \times GNP + DF$$

$$4. C = GNP - I - G - (Ex - M)$$

Investment

$$5. I = a \times X_k - C_k - G_k - Ex_k - R_k$$

$$6. I_i = b_i \times I$$

Capital Formation

$$7. KF_i = f(I_i, I(-1)_i, r_i)$$

$$8. K_i = K_i(-1) + KF_i(-1)$$

Employment

$$9. LF = p \times POP$$

$$10. N = er \times LF$$

$$11. N_i = c_i \times N$$

Energy

$$12. E_{i,j} = K_i \times d_{i,j}$$

$$13. \bar{E}_{i,j} = E_{i,j} \times e_{i,j}$$

$$14. R_j = Q_j - \sum_i \bar{E}_{i,j} - \bar{E}_{fa,j}$$

$$15. D_i = (\sum_j \bar{E}_{i,j} \times h_j) / (\sum_j E_{i,j} \times h_j)$$

$$16. \bar{K}_i = K_i \times (1 - g_i \times (1 - D_i))$$

Foreign Trade

$$17. EH_j = R_j - EC_j$$

$$18. MH_c = \sum_j EH_j + T$$

$$19. MH = f(MH_c, \bar{MH})$$

B. Variables

C	Private consumption	Ex_k	Machinery exports	MH_c	Hard currency import capacity
C_k	Expenditures on consumer durables	G	Government expenditures	N	Total employment
D_i	Deliveries of fuels and power to sector i as a percent of nominal requirements	G_k	Defense expenditures on capital goods	N_i	Employment in sector i
DF	Defense Spending	GNP	Gross national product	POP	Able-bodied population
E_{ij}	Nominal requirements of energy type j in sector i	I	Total investment	Q_j	Gross output of energy type j
\bar{E}_{ij}	Deliveries of energy type j to sector i	I_i	Investment in sector i	R_j	Residual of domestic production of energy type j after deduction for domestic deliveries
\bar{E}_{fbj}	Deliveries of energy type j to final demand	K_i	Nominal capital stock in sector i	R_k	Capital repair
EC_j	Net exports of energy type j to Communist and other countries	\bar{K}_i	Active capital stock in sector i	T	Net earnings of hard currency (other than through trade in fuels) and net credit drawings
EH_j	Net exports of energy type j to hard currency countries	KF_i	Net capital formation in sector i	X_i	Value added in sector i
Ex	Exports	LF	Civilian labor force	X_k	Value added in machinery and construction sectors
		M	Imports		
		MH	Imports from hard currency countries		
		\bar{MH}	Minimum imports from hard currency countries		

C. Parameters

a	Ratio of deliveries to final demand of machinery and construction to value added in these sectors	er	Employment rate	p	Participation rate
b_i	Share of total investment going to sector i	e_{ij}	Deliveries of energy type j to sector i as a percent of nominal requirements	r_i	Depreciation rate of capital in sector i
c_i	Share of total employment in sector i	g_i	Elasticity of active capital with respect to input of energy in sector i	t	Share of output devoted to administration and research and development
d_{ij}	Input of energy type j per unit of capital in sector i	h_j	Units of standard fuel per unit of energy type j		